FCC RF TEST REPORT

ISSUED BY
Shenzhen BALUN Technology Co., Ltd.

FOR

Cyclone

ISSUED TO
Wuxi Mirarobot Science & Technology Co., Ltd.

Qingyun Building5, NO.99, Furongsan Road, Xishan Economic -Technological Development Zone, Wuxi, Jiangsu, China

Report No.:	BL- EC1830066-602
EUT Name:	Cyclone
Model Name:	S85 FPV RTF
Brand Name:	Mirarobot
Test Standard:	47 CFR Part 15 Subpart E
FCC ID:	2ANYO-MMRTS85R
Test conclusion:	Pass
Test Date:	Mar. 19, 2018 ~ Mar. 26, 2018
Date of Issue:	Mar. 30, 2018

Tested by: Hu Chao
Hu Chao
(Engineer)
Date Mar. 30, 2018

Approved by:
Liao Jianming
(Technical Director)
Date Mar. 30, 2018

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Revision History

Version	Issue Date	Revisions Content
Rev. 01	Mar. 30, 2018	Initial Issue

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1 ADMINISTRATIVE DATA (GENERAL INFORMATION)

1.1 Identification of the Testing Laboratory

Company Name	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Phone Number	+86 755 6685 0100

1.2 Identification of the Responsible Testing Location

Test Location	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Accreditation Certificate	The laboratory has been listed by Industry Canada to perform electromagnetic emission measurements. The recognition numbers of test site are 11524A-1. The laboratory is a testing organization accredited by FCC as a accredited testing laboratory. The designation number is CN1196. The laboratory is a testing organization accredited by American Association for Laboratory Accreditation(A2LA) according to ISO/IEC 17025.The accreditation certificate is 4344.01. The laboratory is a testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L6791.
Description	All measurement facilities used to collect the measurement data are located at Block B, FL 1, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China 518055

1.3 Laboratory Condition

Ambient Temperature	20 to 25℃
Ambient Relative Humidity	45% - 55%
Ambient Pressure	100 kPa - 102 kPa

1.4 Announce

(1) The test report reference to the report template version v4.1.

(2) The test report is invalid if not marked with the signatures of the persons responsible for preparing and approving the test report.

(3) The test report is invalid if there is any evidence and/or falsification.

(4) The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein.

(5) This document may not be altered or revised in any way unless done so by BALUN and all revisions are duly noted in the revisions section.

(6) Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.

2 PRODUCT INFORMATION

2.1 Applicant

Applicant	Wuxi Mirarobot Science&Technology Co., Ltd.
Address	Qingyun Building5, NO.99, Furongsan Road, Xishan Economic-Technological Development Zone, Wuxi, Jiangsu, China

2.2 Manufacturer

Manufacturer	Wuxi Mirarobot Science & Technology Co., Ltd.
Address	Qingyun Building5, NO.99, Furongsan Road, Xishan Economic-Technological Development Zone, Wuxi, Jiangsu, China

2.3 Factory

Factory	Wuxi Mirarobot Science & Technology Co., Ltd.
Address	Qingyun Building5, NO.99, Furongsan Road, Xishan Economic-Technological Development Zone, Wuxi, Jiangsu, China

2.4 General Description for Equipment under Test (EUT)

EUT Type	Cyclone
Model Name Under Test	S85 FPV RTF
Series Model Name	N/A
Description of Model name differentiation	N/A
Hardware Version	V3.0
Software Version	V1.0
Network and Wireless connectivity	2.4GHz ISM Band(GFSK modulation) 5725MHz-5850MHz(FM modulation)
About Product	

2.5 Ancillary Equipment

Ancillary Equipment 1	Battery 1	
	Brand Name	SHIDA
	Model No.	SDL-HW651855SP-500mAh
	Serial No.	N/A
	Capacity	500 mAh
	Rated Voltage	3.8 V
	Limit Charge Voltage	4.35 V
Ancillary Equipment 2	Battery 2	
	Brand Name	N/A
	Model No.	LR6 AA
	Serial No.	N/A
	Capacity	N/A
	Rated Voltage	1.5 V
	Limit Charge Voltage	N/A
Ancillary Equipment 3	Adapter	
	Brand Name	Mirarobot
	Model Name	MRK C1000
	Rated Input	5 V⎓ 500 mA
	Rated Output	4.35 V⎓ 500 mA

2.6 Technical Information

Frequency Range	The frequency range used is 5725 MHz – 5850 MH
Product Type	☒ Mobile ☐ Portable ☐ Fix Location
Modulation technology	FM
Number of channel	32 (See note 1)
Tested Channel	Low Channel (5732 MHz), Middle Channel(5800 MHz), High Channel (5847 MHz)
Antenna Type	Dipole Antenna
Antenna Gain	0 dBi

Channel List

Group A:

Number	Frequency (MHz)	Number	Frequency (MHz)
1	5740	5	5820
2	5760	6	5840
3	5780	7	5840
4	5800	8	5840

Group B:

Number	Frequency (MHz)	Number	Frequency (MHz)
1	5845	5	5785
2	5845	6	5765
3	5825	7	5745
4	5805	8	5745

Group C:

Number	Frequency (MHz)	Number	Frequency (MHz)
1	5732	5	5806
2	5732	6	5843
3	5732	7	5843
4	5769	8	5843

Group D:

Number	Frequency (MHz)	Number	Frequency (MHz)
1	5733	5	5809
2	5752	6	5828
3	5771	7	5847
4	5790	8	5847

Note: The above EUT information in section 2.4 and 2.6 was declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.

3 SUMMARY OF TEST RESULTS

3.1 Test Standards

No.	Identity	Document Title
1	47 CFR Part 15 Subpart E (10-1-16 Edition)	Unlicensed National Information Infrastructure Devices
2	KDB Publication 789033 D02v01r04	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices Part 15, Subpart E
3	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices

3.2 Verdict

No.	Description	FCC Part No.	Test Result	Verdict
1	Antenna Requirement	15.203	--	Pass[Note1]
2	RF Output Power	15.407(a)	ANNEX A.1	Pass
3	Emission Bandwidth & 99% Occupied Bandwidth	15.407(a)	ANNEX A.2	Pass
4	6 dB bandwidth	15.407(e)	ANNEX A.3	Pass
5	Power Spectral Density	15.407(a)	ANNEX A.4	Pass
6	Conducted Emission	15.207	ANNEX A.5	Pass
7	Conducted Spurious Emission and Band Edge (Authorized-band)	15.407(b) 15.209	ANNEX A.6	Pass
8	Radiated Spurious Emissions and Band Edge (Restricted-band)	15.407(b)	ANNEX A.7	Pass
9	Frequency Stability	15.407(g)	ANNEX A.8	Pass
Note [1]: The EUT has a permanently and irreplaceable attached antenna, which complies with the requirement FCC 15.203.				

4 GENERAL TEST CONFIGURATIONS

4.1 Test Environments

During the measurement, the normal environmental conditions were within the listed ranges:

Relative Humidity	45% - 55%	
Atmospheric Pressure	100 kPa - 102 kPa	
Temperature	NT (Normal Temperature)	+22℃ to +25℃
	LT (Low Temperature)	5℃
	HT (High Temperature)	+45℃
Working Voltage of the EUT	NV (Normal Voltage)	3.8 V
	LV (Low Voltage)	3.0 V
	HV (High Voltage)	4.35 V

4.2 Test Equipment List

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer	ROHDE&SCHWARZ	FSV-30	103118	2017.06.12	2018.06.11
Switch Unit with OSP-B157	ROHDE&SCHWARZ	OSP120	101270	2017.06.12	2018.06.11
EMI Receiver	KEYSIGHT	N9038A	MY53220118	2017.09.07	2018.09.06
EMI Receiver	ROHDE&SCHWARZ	ESRP	101036	2017.06.22	2018.06.21
LISN	SCHWARZBECK	NSLK 8127	8127-687	2017.06.22	2018.06.21
Bluetooth Tester	ROHDE&SCHWARZ	CBT	101005	2017.06.12	2018.06.11
Power Splitter	KMW	DCPD-LDC	1305003215	--	--
Power Sensor	ROHDE&SCHWARZ	NRP-Z21	103971	2017.06.12	2018.06.11
Attenuator (20 dB)	KMW	ZA-S1-201	110617091	--	--
DC Power Supply	ROHDE&SCHWARZ	HMP2020	018141664	2017.06.22	2018.06.21
Temperature Chamber	ANGELANTIONI SCIENCE	NTH64-40A	1310	2017.06.27	2018.06.26
Test Antenna-Loop(9 kHz-30 MHz)	SCHWARZBECK	FMZB 1519	1519-037	2017.07.22	2019.07.21
Test Antenna-Bi-Log(30 MHz-3 GHz)	SCHWARZBECK	VULB 9163	9163-624	2016.07.12	2018.07.11
Test Antenna-Horn(1-18 GHz)	SCHWARZBECK	BBHA 9120D	9120D-1148	2017.06.12	2018.06.11
Test Antenna-Horn(15-26.5 GHz)	SCHWARZBECK	BBHA 9170	9170-305	2017.06.22	2018.06.21
Anechoic Chamber	RAINFORD	9m*6m*6m	N/A	2017.02.21	2019.02.20
Anechoic Chamber	EMC Electronic Co., Ltd	20.10*11.60 *7.35m	N/A	2016.08.09	2018.08.08
Shielded Enclosure	ChangNing	CN-130701	130703	--	--
Signal Generator	ROHDE&SCHWARZ	SMB100A	177746	2017.06.12	2018.06.11
Power Amplifier	OPHIR RF	5225F	1037	2018.02.17	2019.02.16
Power Amplifier	OPHIR RF	5273F	1016	2018.02.17	2019.02.16

4.3 Measurement Uncertainty

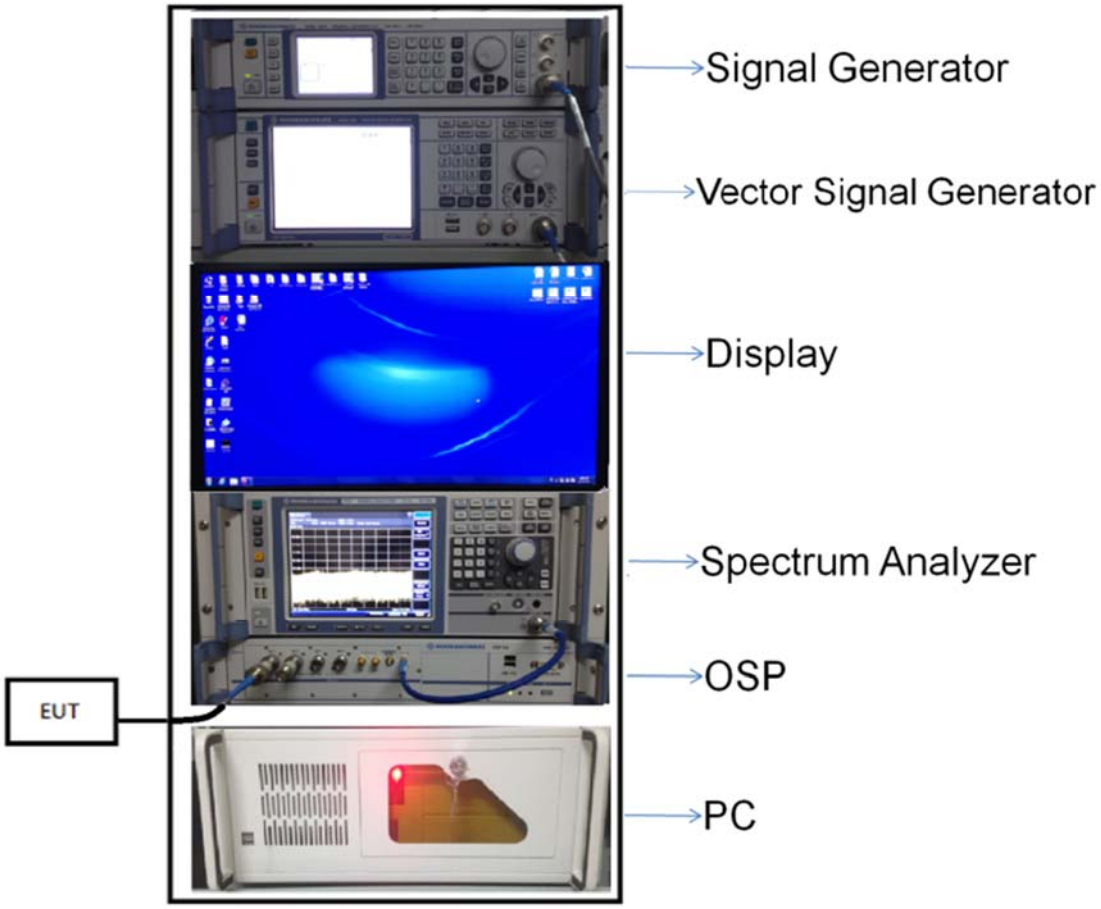
The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2.

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Measurement	Value
Occupied Channel Bandwidth	±4%
RF output power, conducted	±1.4 dB
Power Spectral Density, conducted	±2.5 dB
Unwanted Emissions, conducted	±2.8 dB
All emissions, radiated	±5.4 dB
Temperature	±1°C
Humidity	±4%

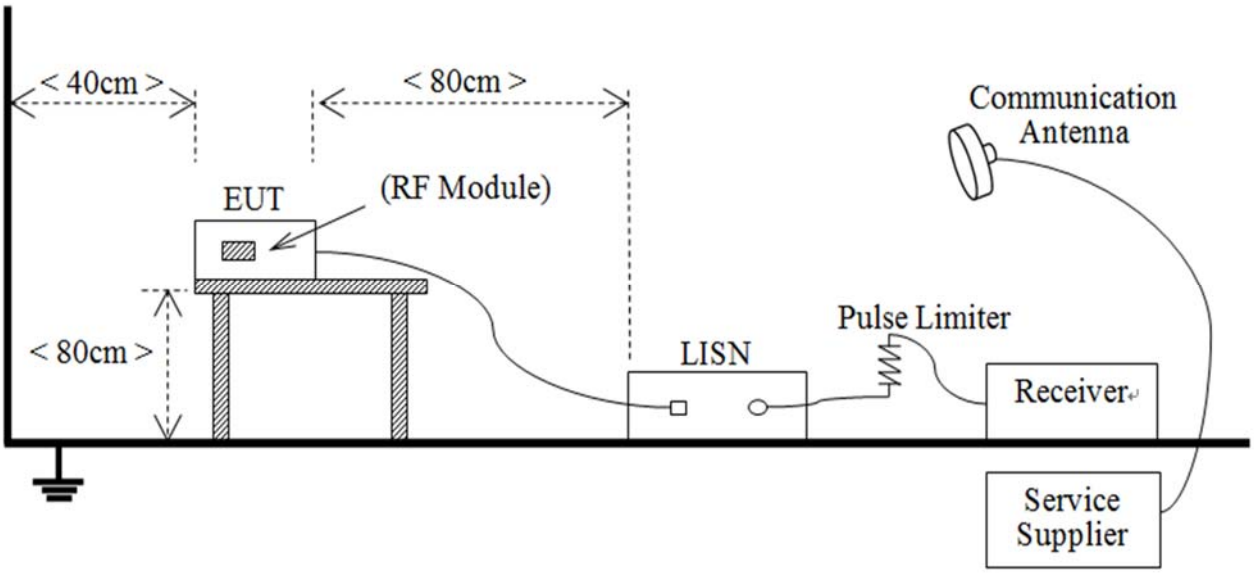
4.4 Description of Test Setup

4.4.1 For Antenna Port Test



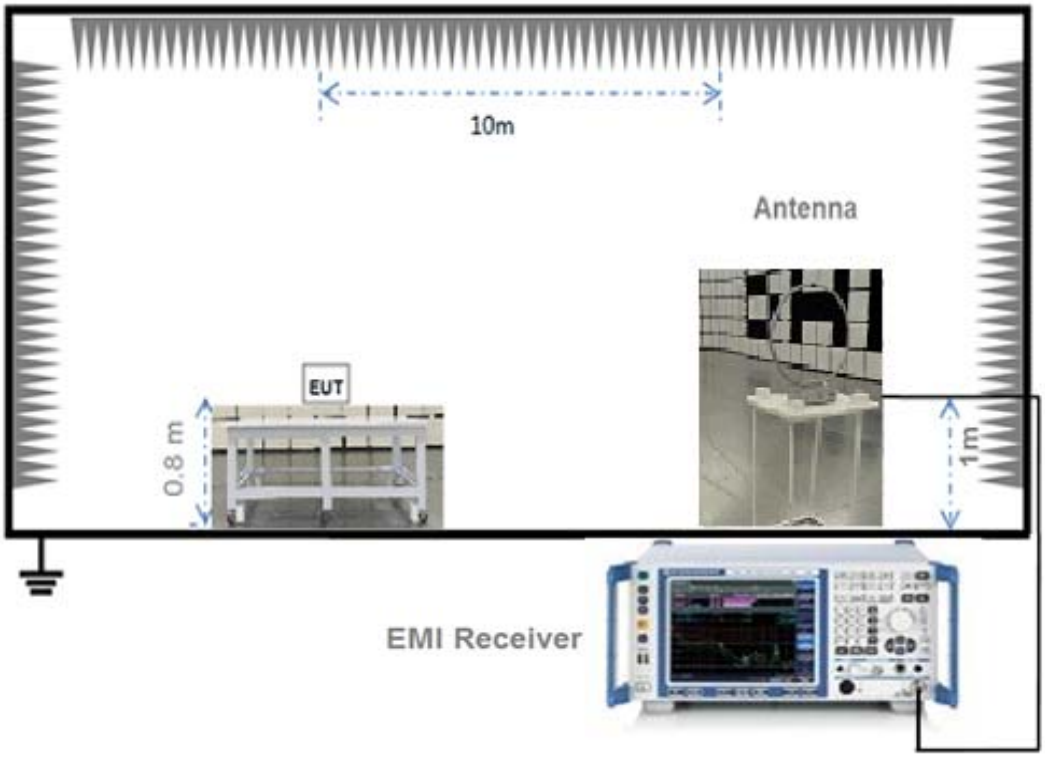
(Diagram 1)

4.4.2 For AC Power Supply Port Test



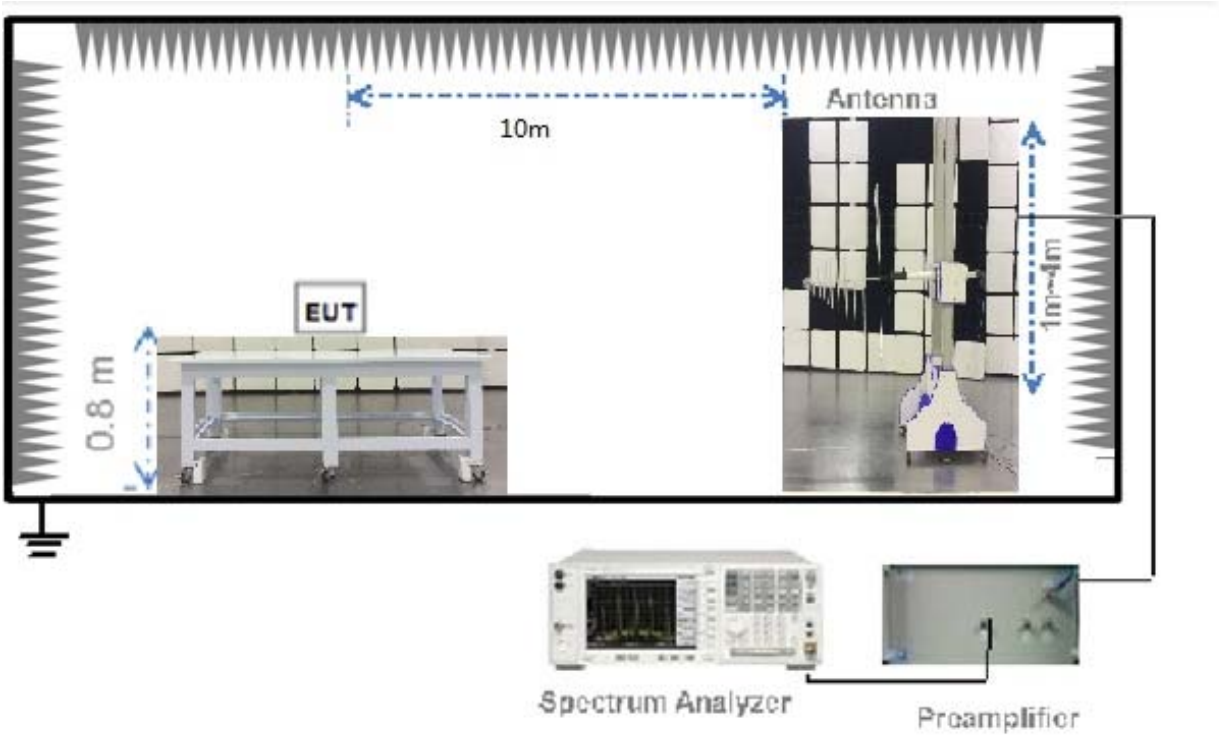
(Diagram 2)

4.4.3 For Radiated Test (Below 30 MHz)



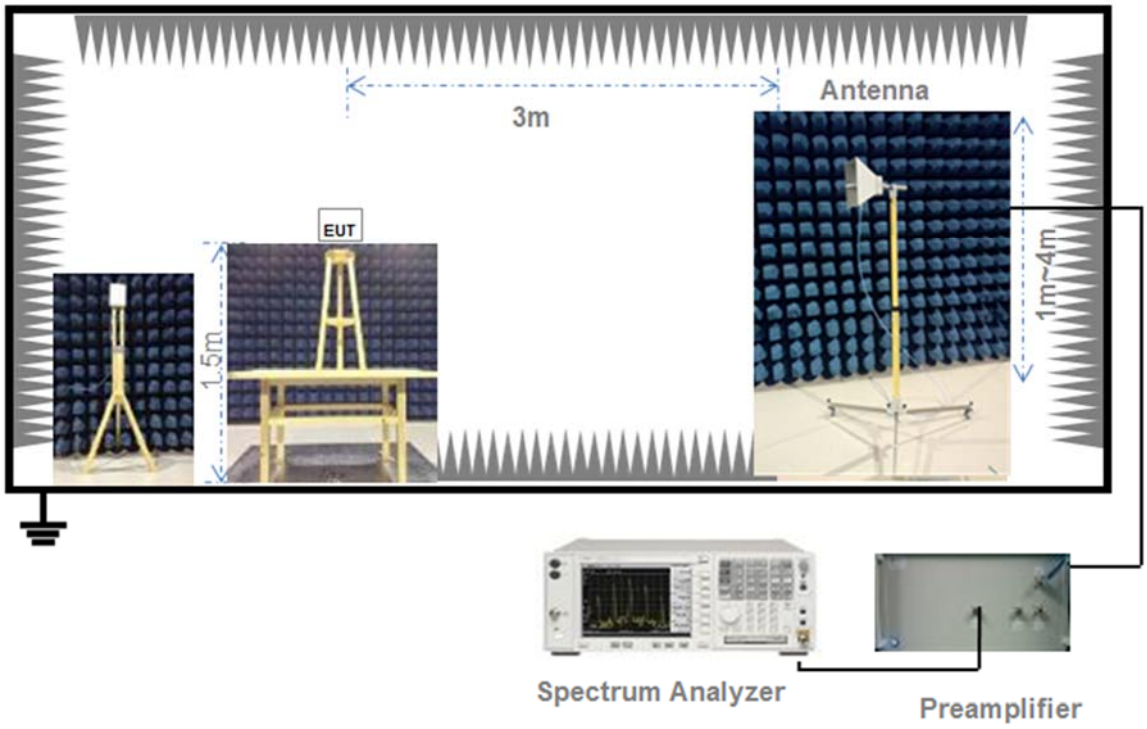
(Diagram 3)

4.4.4 For Radiated Test (30 MHz-1 GHz)



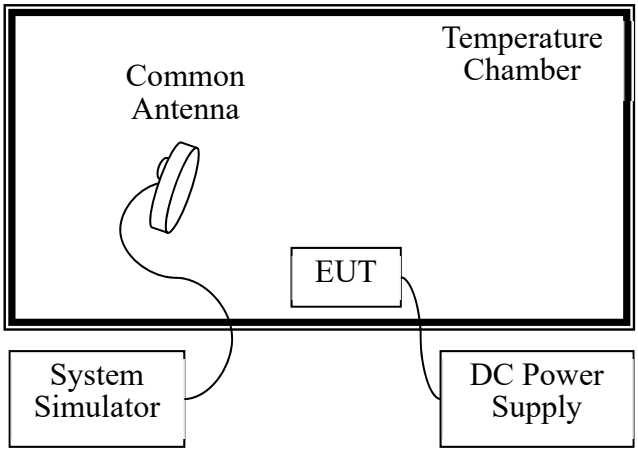
(Diagram 4)

4.4.5 For Radiated Test (Above 1 GHz)



(Diagram 5)

4.4.6 For Frequency Stability Test



(Diagram 6)

5 TEST ITEMS

5.1 RF Output Power

5.1.1 Test Limit

FCC §15.407(a)

The maximum conducted output power should not exceed:

Frequency Band (MHz)	Limit
5725-5850	1 W
Note: Where “B” is the 26 dB emissions bandwidth in MHz.	

5.1.2 Test Setup

The section 4.4.1 (Diagram 1) test setup description was used for this test. The photo of test setup please refer to ANNEX B.

5.1.3 Test Procedure

The maximum peak conducted output power may be measured using a broadband Average RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the emission bandwidth and utilize a fast-responding diode detector.

The E.I.R.P used radiated test method. At a test site that has been validated using the procedures of ANSI C63.4 or the latest CISPR 16-1-4 for measurements above 1 GHz, so as to simulate a near free-space environment.

5.1.4 Test Result

Please refer to ANNEX A.1.

5.2 Emission Bandwidth and 6 dB Bandwidth

5.2.1 Limit

FCC §15.407(a), RSS-247, 6.2

Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

5.2.2 Test Setup

The test setup photo please refer to 4.4.1 (Diagram 1) test setup description was used for this test. The photo of test setup please refer to ANNEX B.

5.2.3 Test Procedure

Emission bandwidth

1. Set RBW = approximately 1% of the emission bandwidth.

2. Set VBW ≥ 3*RBW,

3. Detector = Peak.

4. Trace mode = Max hold.

5. Measure the maximum width of the emission that is 26 dB down from the peak of the emission.

Occupied Bandwidth

1. Set Span = 1.5 times to 5.0 times the OBW

2. Set RBW = 1% to 5% of the OBW.

3. Set VBW ≥ 3*RBW, Detector = Peak.

4. Trace mode = Max hold.

5. Use the 99% power bandwidth function of the instrument.

6 dB bandwidth

1. Set RBW = 100 kHz, VBW = 300 kHz.

2. Detector = Peak.Trace mode = Max hold.

3. Allow the trace to stabilize.

4. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

5.2.4 Test Result

Please refer to ANNEX A.2 and ANNEX A.3.

5.3 Power Spectral density (PSD)

5.3.1 Limit

FCC §15.407(a)

The maximum power spectral density should not exceed:

Frequency Band (MHz)	Limit
5725-5850	30 dBm/500kHz

5.3.2 Test Setup

The section 4.4.1 (Diagram 1) test setup description was used for this test. The photo of test setup please refer to ANNEX B.

5.3.3 Test Procedure

Set the spectrum analyzer or EMI receiver span to view the entire emission bandwidth.

1. Set RBW = 500 kHz/MHz, VBW ≥ 3*RBW, Sweep time = Auto, Detector = RMS.
2. Allow the sweeps to continue until the trace stabilizes.
3. Use the peak marker function to determine the maximum amplitude level.
4. The E.I.R.P spectral density used radiated test method. At a test site that has been validated using the procedures of ANSI C63.4 or the latest CISPR 16-1-4 for measurements above 1 GHz, so as to simulate a near free-space environment.

5.3.4 Test Result

Please refer to ANNEX A.4.

5.4 Conducted Emission

5.4.1 Limit

FCC §15.207, RSS-GEN, 8.8

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50μH/50Ω line impedance stabilization network (LISN).

Frequency range (MHz)	Conducted Limit (dBμV)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
0.50 - 30	60	50

5.4.2 Test Setup

The section 4.4.2 (Diagram 2) test setup description was used for this test. The photo of test setup please refer to ANNEX B.

5.4.3 Test Procedure

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.

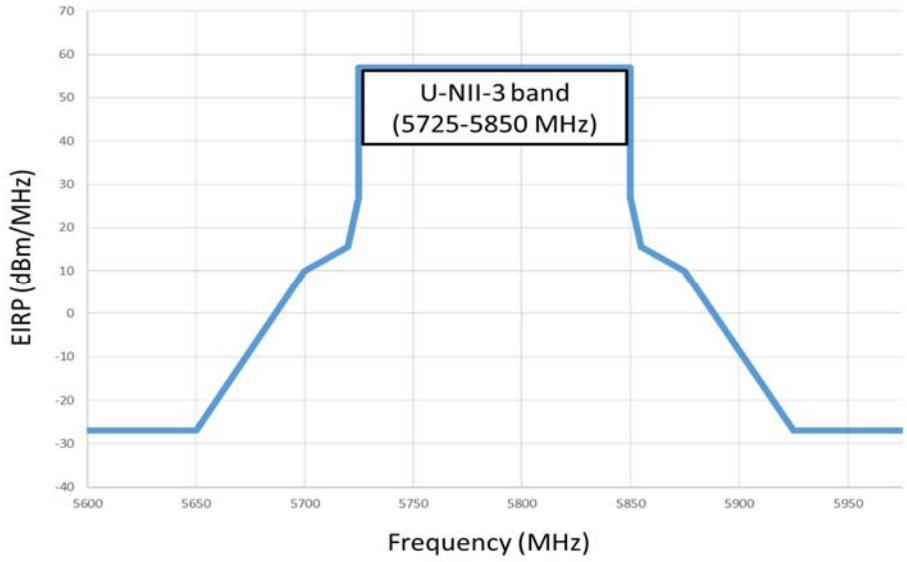
5.4.4 Test Result

Please refer to ANNEX A.5.

5.5 Conducted Spurious Emission and Band Edge (Authorized-band)

5.5.1 Limit

FCC §15.407(b)

Un-restricted band emissions	
Frequency Band (MHz)	Limit
5725 - 5850	All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge. 

5.5.2 Test Setup

See section 4.4.2 (Diagram 2) for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.5.3 Test Procedure

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold
Allow the trace to stabilize

5.5.4 Test Result

Please refer to ANNEX A.6.

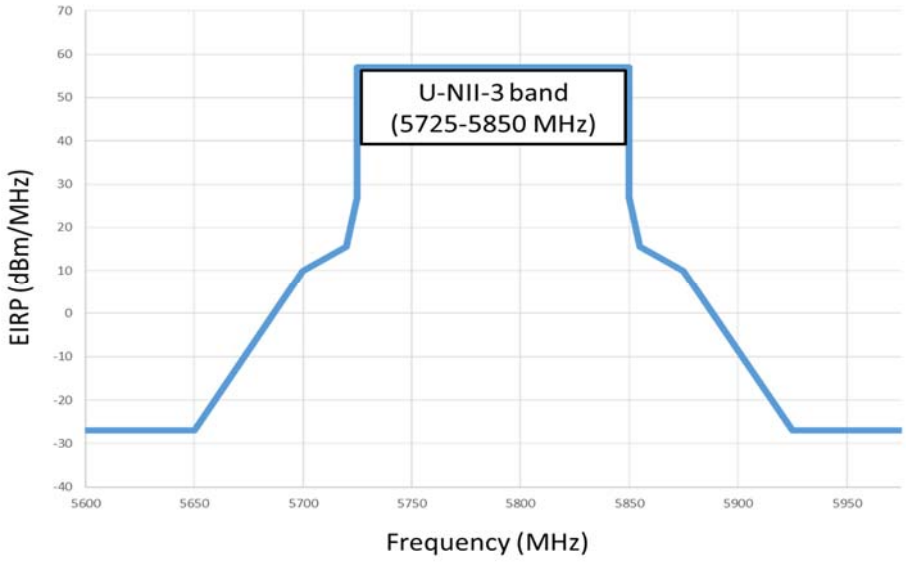
5.6 Radiated Spurious Emissions and Band Edge (Restricted-band)

5.6.1 Limit

FCC §15.209 & 15.407(b), RSS-247, 6.2

Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

Note [1]: The Limit for radiated test was performed according to FCC Part 15C
Note [2]: The tighter limit applies at the band edge.

Un-restricted band emissions	
Out Operating Band (MHz)	Limit
5725 - 5850	All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge. 

Note: The following formula is used to convert the equipment isotropic radiated power (eirp) to field strength.

5.6.2 Test Setup

The section 4.4.3-4.4.5 (Diagram 3 - Diagram 5) test setup description was used for this test. The photo of test setup please refer to ANNEX B.

5.6.3 Test Procedure

Since the emission limits are specified in terms of radiated field strength levels, measurements performed to demonstrate compliance have traditionally relied on a radiated test configuration. Radiated measurements remain the principal method for demonstrating compliance to the specified limits; however antenna-port conducted measurements are also now acceptable to demonstrate compliance (see below for details). When radiated measurements are utilized, test site requirements and procedures for maximizing and measuring radiated emissions that are described in ANSI C63.10 shall be followed.

Antenna-port conducted measurements may also be used as an alternative to radiated measurements for demonstrating compliance in the restricted frequency bands. If conducted measurements are performed, then proper impedance matching must be ensured and an additional radiated test for cabinet/case spurious emissions is required.

General Procedure for conducted measurements in restricted bands

a) Measure the conducted output power (in dBm) using the detector specified (see guidance regarding measurement procedures for determining quasi-peak, peak, and average conducted output power, respectively).

b) Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level (see guidance on determining the applicable antenna gain)

c) Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies ≤ 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000 MHz).

d) For devices with multiple antenna-ports, measure the power of each individual chain and sum the EIRP of all chains in linear terms (e.g., Watts, mW).

e) Convert the resultant EIRP level to an equivalent electric field strength using the following relationship:

$E = EIRP – 20\log D + 104.8$

where:

E = electric field strength in dBμV/m,

EIRP = equivalent isotropic radiated power in dBm

D = specified measurement distance in meters.

f) Compare the resultant electric field strength level to the applicable limit.

g) Perform radiated spurious emission test.

Quasi-Peak measurement procedure

The specifications for measurements using the CISPR quasi-peak detector can be found in Publication 16 of the International Special Committee on Radio Frequency Interference (CISPR) of the International Electrotechnical Commission.

As an alternative to CISPR quasi-peak measurement, compliance can be demonstrated to the applicable emission limits using a peak detector.

Peak power measurement procedure

Peak emission levels are measured by setting the instrument as follows:

a) RBW = as specified in Table 1.

b) VBW ≥ 3 x RBW.

c) Detector = Peak.

d) Sweep time = auto.

e) Trace mode = max hold.

f) Allow sweeps to continue until the trace stabilizes. (Note that the required measurement time may be longer for low duty cycle applications).

Table 1—RBW as a function of frequency

Frequency	RBW
9-150 kHz	200-300 Hz
0.15-30 MHz	9-10 kHz
30-1000 MHz	100-120 kHz
> 1000 MHz	1 MHz

If the peak-detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement.

Trace averaging across on and off times of the EUT transmissions followed by duty cycle correction

If continuous transmission of the EUT (i.e., duty cycle ≥ 98 percent) cannot be achieved and the duty cycle is constant (i.e., duty cycle variations are less than ± 2 percent), then the following procedure shall be used:

a) The EUT shall be configured to operate at the maximum achievable duty cycle.

b) Measure the duty cycle, x, of the transmitter output signal as described in section 6.0.

c) RBW = 1 MHz (unless otherwise specified).

d) VBW ≥ 3 x RBW.

e) Detector = RMS, if span/(# of points in sweep) ≤ (RBW/2). Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak.

f) Averaging type = power (i.e., RMS).

1) As an alternative, the detector and averaging type may be set for linear voltage averaging.

2) Some instruments require linear display mode in order to use linear voltage averaging. Log or dB averaging shall not be used.

g) Sweep time = auto.

h) Perform a trace average of at least 100 traces.

i) A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:

1) If power averaging (RMS) mode was used in step f), then the applicable correction factor is 10 log(1/x), where x is the duty cycle.

2) If linear voltage averaging mode was used in step f), then the applicable correction factor is 20 log(1/x), where x is the duty cycle.

3) If a specific emission is demonstrated to be continuous (≥ 98 percent duty cycle) rather than turning on and off with the transmit cycle, then no duty cycle correction is required for that emission.

NOTE: Reduction of the measured emission amplitude levels to account for operational duty factor is not permitted. Compliance is based on emission levels occurring during transmission - not on an average across on and off times of the transmitter.

Determining the applicable transmit antenna gain

A conducted power measurement will determine the maximum output power associated with a restricted band emission; however, in order to determine the associated EIRP level, the gain of the transmitting antenna (in dBi) must be added to the measured output power (in dBm).

Since the out-of-band characteristics of the EUT transmit antenna will often be unknown, the use of a conservative antenna gain value is necessary. Thus, when determining the EIRP based on the measured conducted power, the upper bound on antenna gain for a device with a single RF output shall be selected as the maximum in-band gain of the antenna across all operating bands, or 2 dBi, whichever is greater. However, for devices that operate in multiple frequency bands while using the same transmit antenna, the highest gain of the antenna within the operating band nearest in frequency to the restricted band emission being measured may be used in lieu of the overall highest gain when the emission is at a frequency that is within 20 percent of the nearest band edge frequency, but in no case shall a value less than 2 dBi be used.

See KDB 662911 for guidance on calculating the additional array gain term when determining the effective antenna gain for a EUT with multiple outputs occupying the same or overlapping frequency ranges in the same band.

Radiated spurious emission test

An additional consideration when performing conducted measurements of restricted band emissions is that unwanted emissions radiating from the EUT cabinet, control circuits, power leads, or intermediate circuit elements will likely go undetected in a conducted measurement configuration. To address this concern, a radiated test shall be performed to ensure that emissions emanating from the EUT cabinet (rather than the antenna port) also comply with the applicable limits.

For these cabinet radiated spurious emission measurements the EUT transmit antenna may be replaced with a termination matching the nominal impedance of the antenna. Procedures for performing radiated measurements are specified in ANSI C63.10. All detected emissions shall comply with the applicable limits.

The measurement frequency range is from 30 MHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

5.6.4 Test Result

Please refer to ANNEX A.7 and Please refer to ANNEX A.9

5.7 Frequency Stability

5.7.1 Limit

FCC §15.407(g)

Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

5.7.2 Test Setup

The section 4.4.6 (Diagram 6) test setup description was used for this test. The photo of test setup please refer to ANNEX B.

5.7.3 Test Procedure

The EUT is installed in an environment test chamber with external power source.
Set the chamber to operate at 50 centigrade and external power source to output at nominal voltage of EUT.
A sufficient stabilization period at each temperatures is used prior to each frequency measurement.
When temperature is stabled, measure the frequency stability.
The test shall be performed under -30 to 50 centigrade and 85 to 115 percent of the nominal voltage.
Change setting of chamber and external power source to complete all conditions.

5.7.4 Test Result

Please refer to ANNEX A.8.

ANNEX A TEST RESULT

A.1 RF Output Power

Test Data

Peak Power Test Data

(5725 - 5850 MHz)					
Channel	Measured Output Peak Power		Limit		Verdict
	dBm	mW	dBm	mW	
Low	9.97	9.93	30	1000	Pass
Middle	9.20	8.32			Pass
High	10.52	11.27			Pass

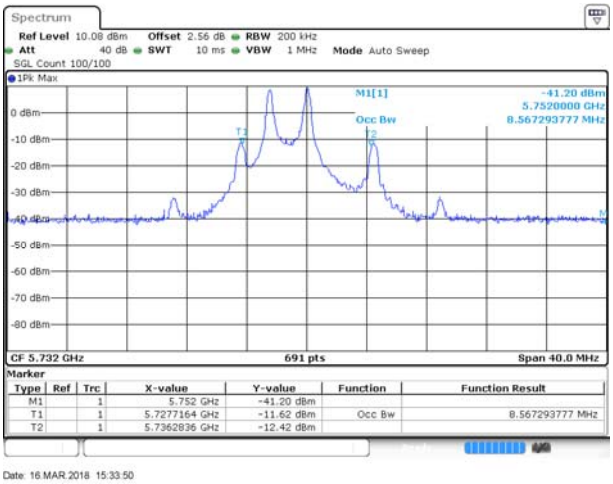
A.2 Emission Bandwidth & 99% Bandwidth

Test Data

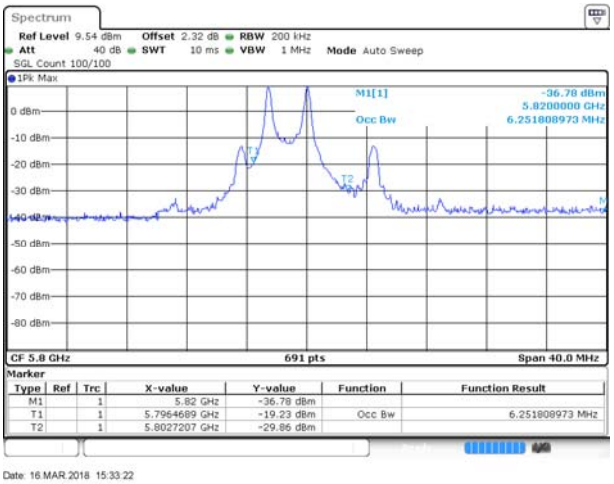
(5725 - 5850 MHz)	
Channel	99% Bandwidth (MHz)
Low	8.57
Middle	6.25
High	8.45

Test plots

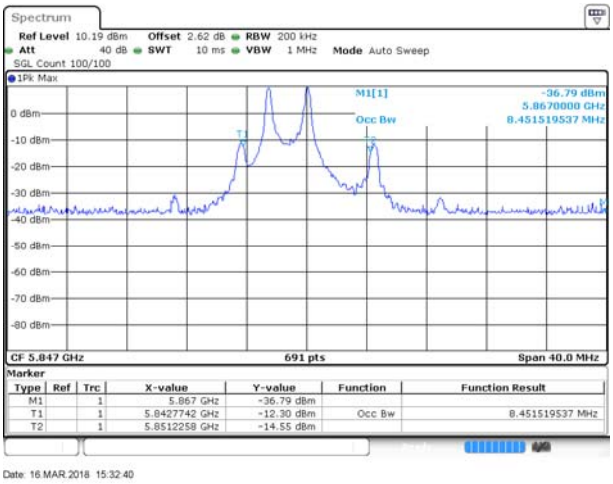
LOW CHANNEL



MIDDLE CHANNEL



HIGH CHANNEL



A.3 6 dB Bandwidth

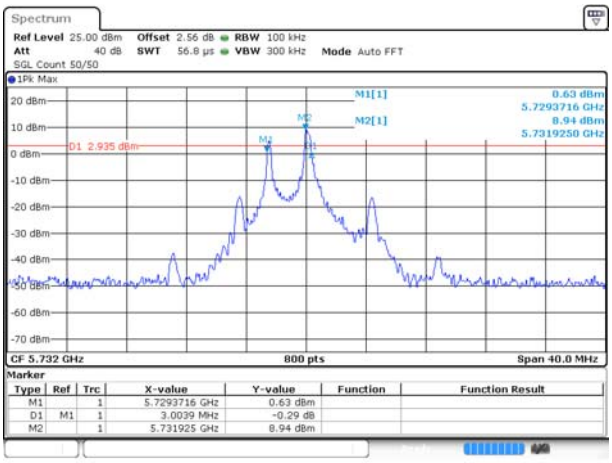
Test Data

(5725 - 5850 MHz)			
Channel	6 dB Bandwidth (MHz)	6 dB Bandwidth Limits (kHz)	Verdict
Low	3.00	⩾500	Pass
Middle	3.00	⩾500	Pass
High	2.95	⩾500	Pass

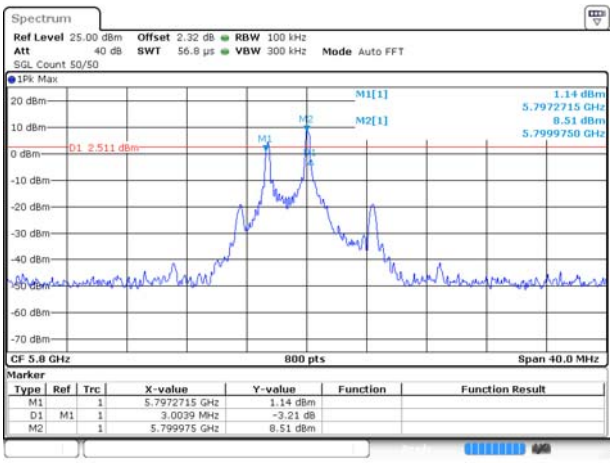
Test plots

6 dB Bandwidth

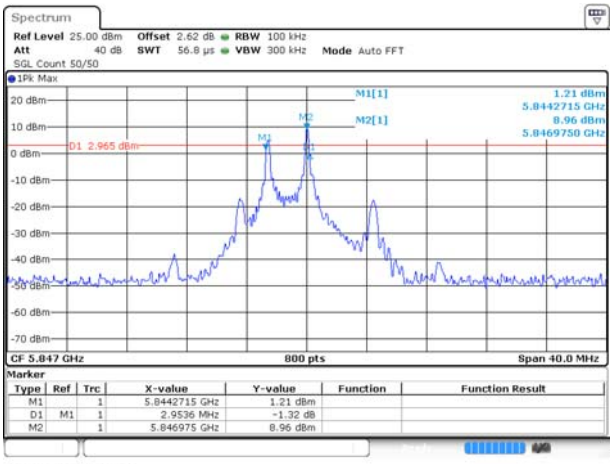
LOW CHANNEL



MIDDLE CHANNEL



HIGH CHANNEL



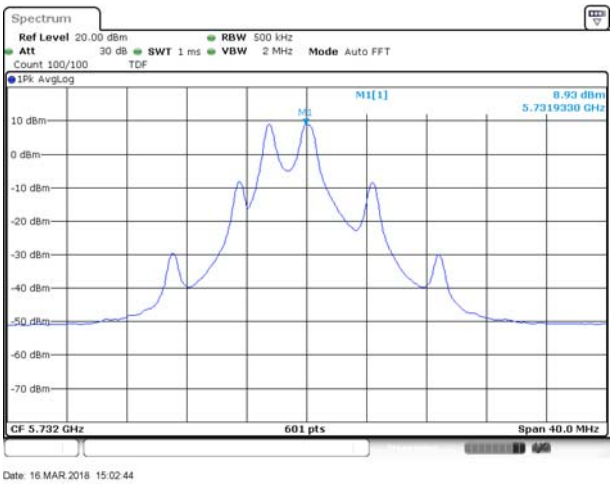
A.4 Power Spectral Density

Test Data

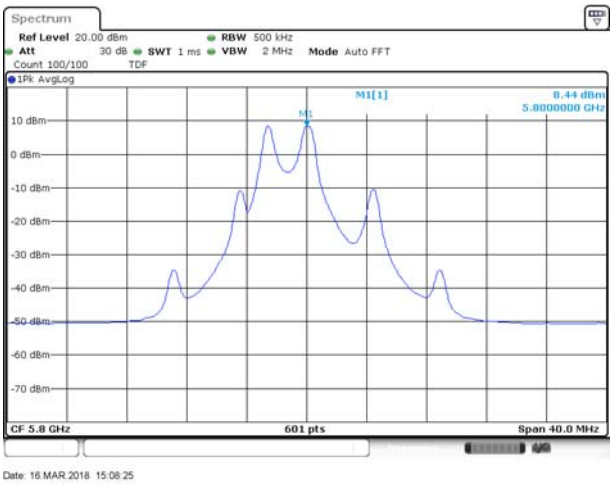
(5725 - 5850 MHz)			
Channel	PSD (dBm/MHz)	FCC Limit(30dBm/500 kHz)	Verdict
Low	8.93	11	Pass
Middle	8.44	11	Pass
High	9.12	11	Pass

Test plosts

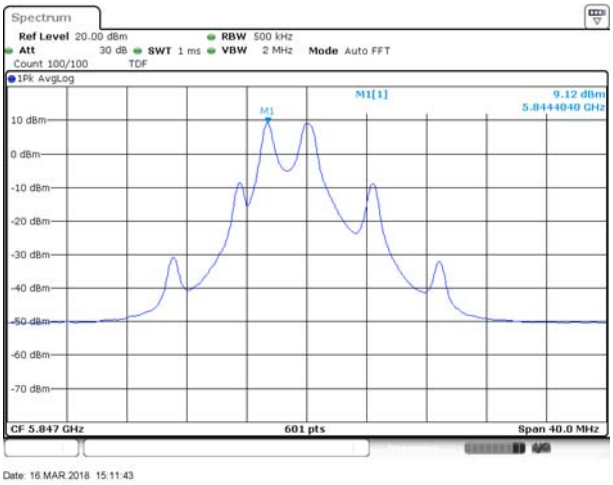
LOW CHANNEL



MIDDLE CHANNEL



HIGH CHANNEL



A.5 Conducted Emissions

Not applicable.

Note [1]: The EUT powered by battery.

A.6 Conducted Spurious Emission and Band Edge (Authorized-band)

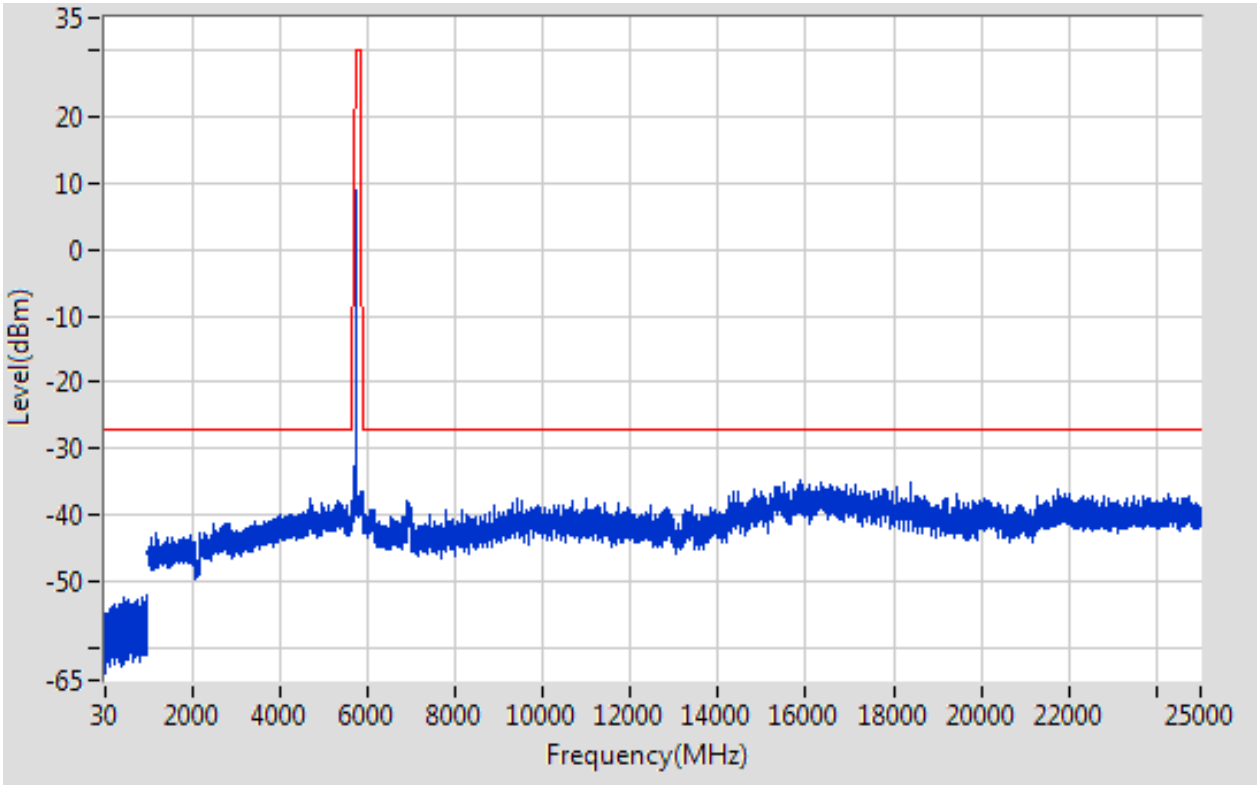
Test data

Test Band (MHz)	Channel	Verdict
5725 - 5850	Low	Pass
	Middle	Pass
	High	Pass

Test plots

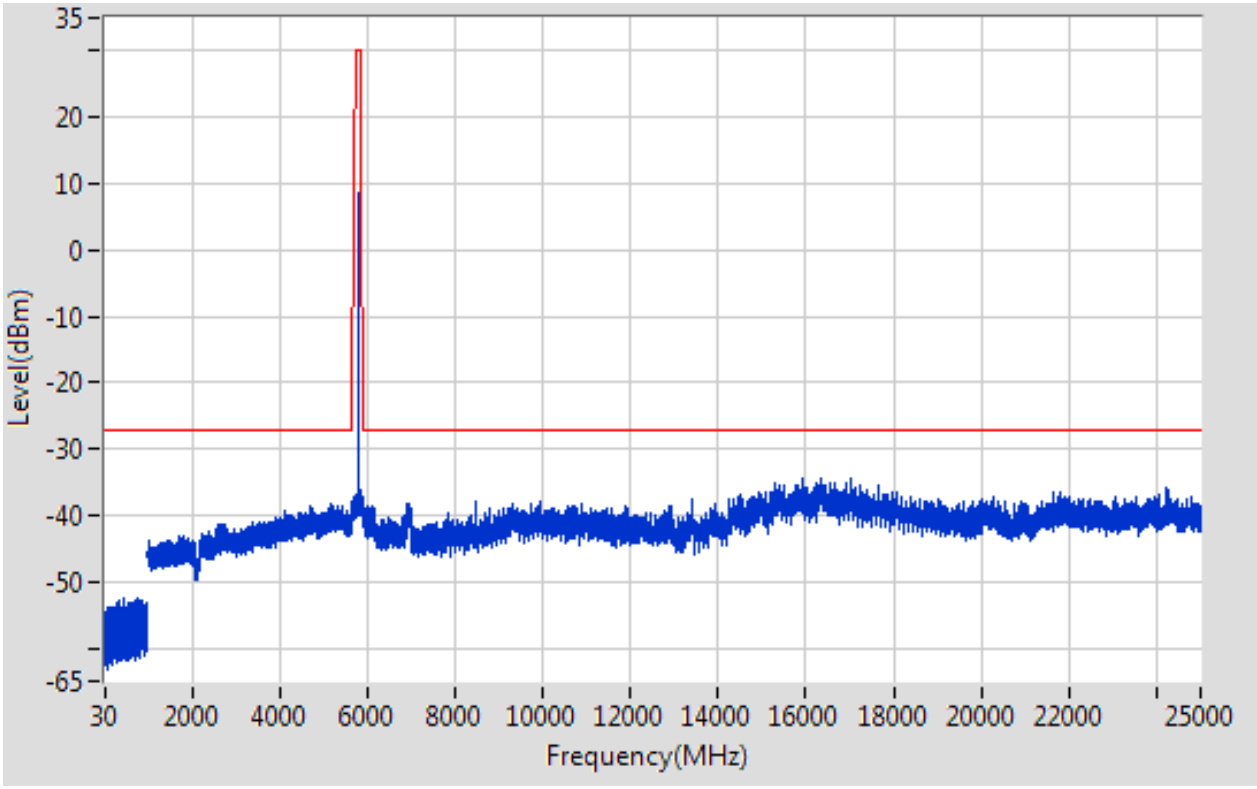
LOW CHANNEL

Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	1000	0.1	Peak	984.698	-52.12	-27	Pass	9700
1000	5650	1	Peak	4710.798	-37.68	-27	Pass	4650
5650	5700	1	Peak	5650.29	-38.76	-26.79	Pass	691
5700	5720	1	Peak	5701.507	-37.76	10.42	Pass	691
5720	5725	1	Peak	5722.688	-27.8	21.73	Pass	691
5725	5850	1	Peak	5729.529	8.99	30	Pass	691
5850	5855	1	Peak	5854.862	-37.33	15.91	Pass	691
5855	5875	1	Peak	5871.783	-36.46	10.9	Pass	691
5875	5925	1	Peak	5924.638	-38.43	-26.73	Pass	691
5925	25000	1	Peak	15876.522	-34.76	-27	Pass	19075



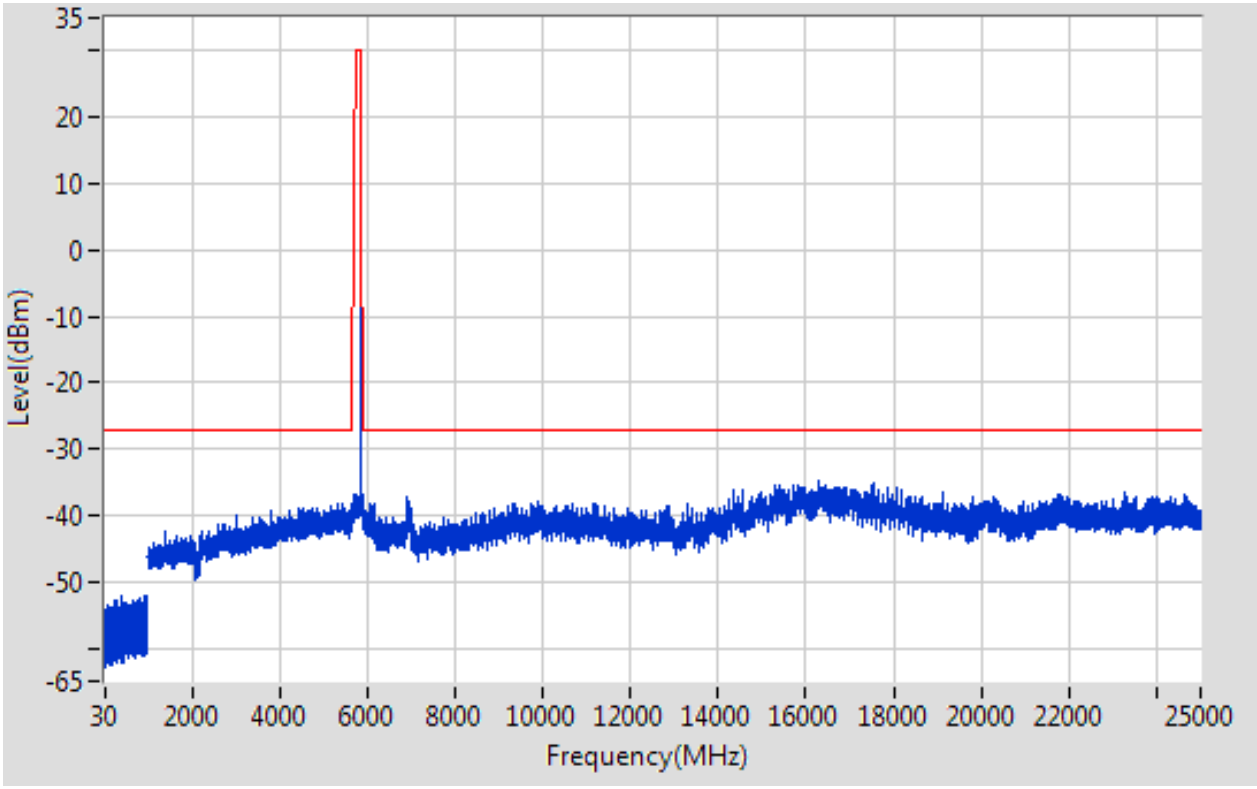
MIDDLE CHANNEL

Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	1000	0.1	Peak	457.544	-52.46	-27	Pass	9700
1000	5650	1	Peak	5161.895	-38.25	-27	Pass	4650
5650	5700	1	Peak	5650.652	-38.07	-26.52	Pass	691
5700	5720	1	Peak	5701.797	-37.75	10.5	Pass	691
5720	5725	1	Peak	5720.08	-37.18	15.78	Pass	691
5725	5850	1	Peak	5800	8.51	30	Pass	691
5850	5855	1	Peak	5854.942	-37.69	15.73	Pass	691
5855	5875	1	Peak	5873.116	-36.73	10.53	Pass	691
5875	5925	1	Peak	5924.855	-38.37	-26.89	Pass	691
5925	25000	1	Peak	16337.546	-34.41	-27	Pass	19075



HIGH CHANNEL

Start Frequency (MHz)	Stop Frequency (MHz)	RBW (MHz)	Detector	Frequency (MHz)	Power (dBm)	Limit (dBm)	Verdict	Sweep Point
30	1000	0.1	Peak	912.491	-51.99	-27	Pass	9700
1000	5650	1	Peak	5425.952	-38.16	-27	Pass	4650
5650	5700	1	Peak	5651.087	-38.6	-26.2	Pass	691
5700	5720	1	Peak	5700	-38.34	10	Pass	691
5720	5725	1	Peak	5720.181	-36.88	16.01	Pass	691
5725	5850	1	Peak	5844.565	9.18	30	Pass	691
5850	5855	1	Peak	5851.514	-8.19	23.55	Pass	691
5855	5875	1	Peak	5855.957	-29.41	15.33	Pass	691
5875	5925	1	Peak	5925	-38.77	-27	Pass	691
5925	25000	1	Peak	16274.543	-34.91	-27	Pass	19075



A.7 Radiated Spurious Emissions and Band Edge (Restricted-band)

A.6.1 Radiated Spurious Emissions

Test Data

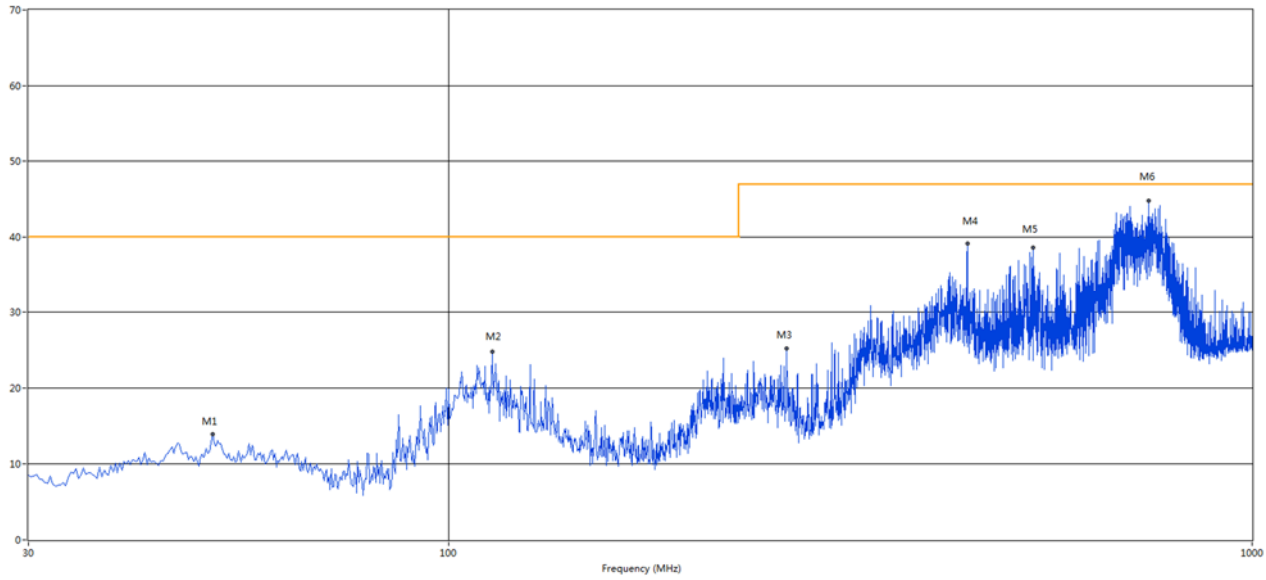
Note [1]: The symbol of "--" in the table which means not application.

Note [2]: For the test data above 1 GHz，According the ANSI C63.4, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

Note [3]: The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

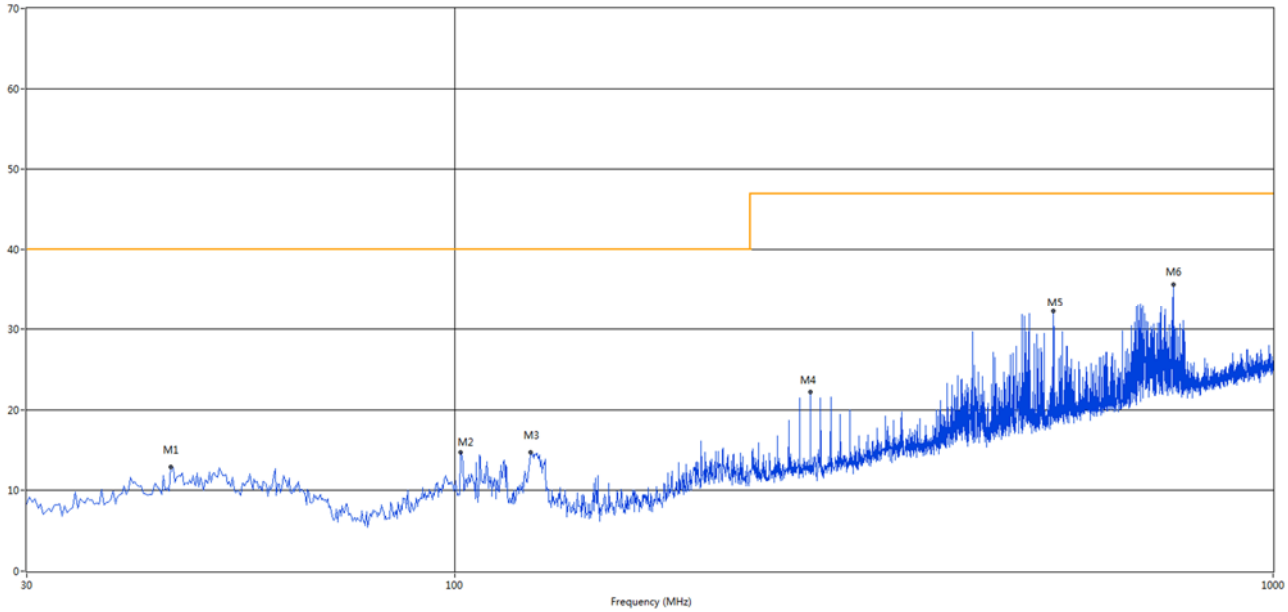
Note [4]: The EUT is working in the Normal link mode below 1 GHz.

30 MHz to 1 GHz, ANT H



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	50.855	13.90	-22.07	40.0	26.10	Peak	0.00	200	Horizontal	Pass
2	113.420	24.78	-24.34	40.0	15.22	Peak	254.70	200	Horizontal	Pass
3	263.285	25.21	-22.23	47.0	21.79	Peak	72.80	100	Horizontal	Pass
4	442.250	39.20	-17.70	47.0	7.80	Peak	66.20	100	Horizontal	Pass
5	534.400	38.67	-15.45	47.0	8.33	Peak	207.30	100	Horizontal	Pass
6	743.541	43.15	-12.24	47.0	3.85	Peak	25.40	200	Horizontal	Pass

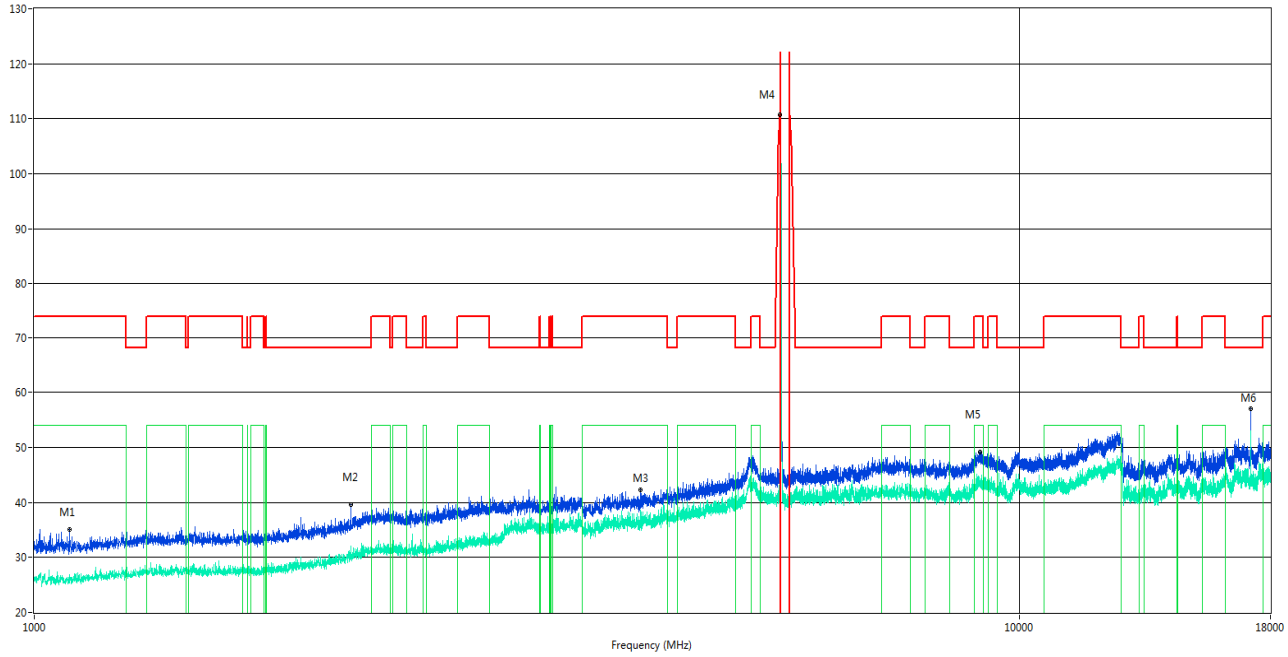
30 MHz to 1 GHz, ANT V



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	45.035	12.90	-22.46	40.0	27.10	Peak	135.80	100	Vertical	Pass
2	101.780	14.70	-23.96	40.0	25.30	Peak	160.20	200	Vertical	Pass
3	123.848	14.74	-26.12	40.0	25.26	Peak	17.30	100	Vertical	Pass
4	272.015	22.16	-21.75	47.0	24.84	Peak	332.80	200	Vertical	Pass
5	538.765	32.04	-15.24	47.0	14.96	Peak	347.10	300	Vertical	Pass
6	755.075	35.08	-11.62	47.0	11.92	Peak	332.80	100	Vertical	Pass

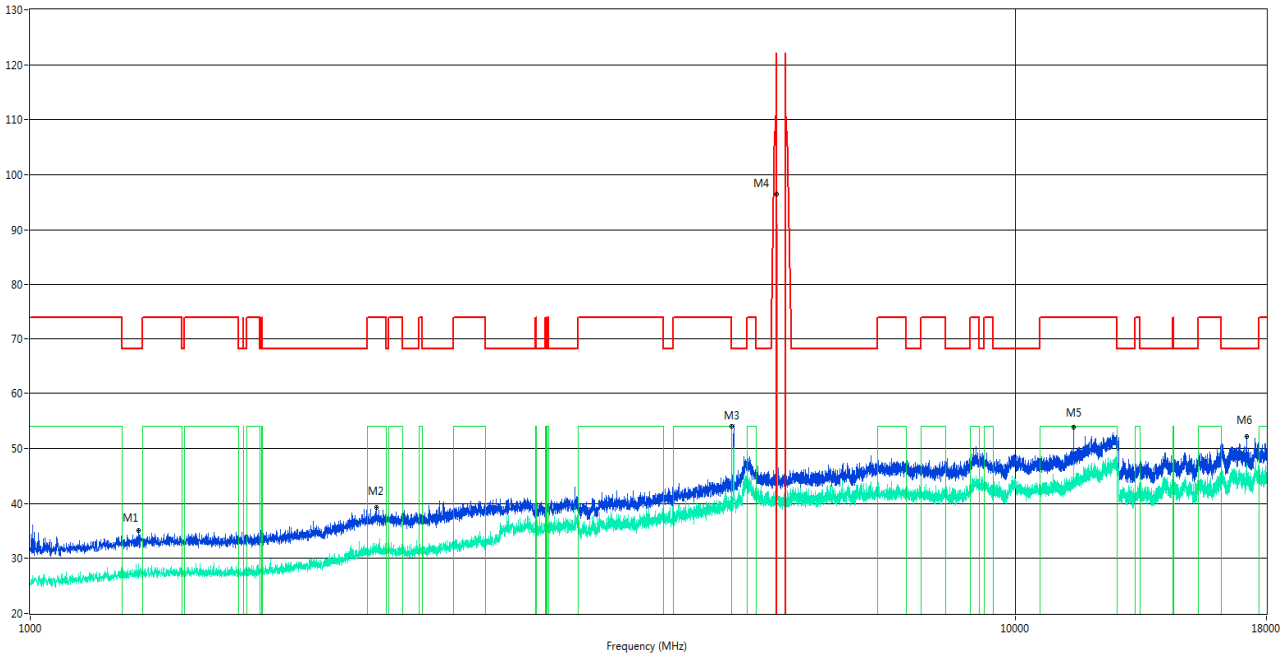
Note 1: The marked spikes near 2400 MHz with circle should be ignored because they are Fundamental signal.
Note 2: The test result of 18~40 GHz is less than 20dB, so it only shown 1 GHz to 18 GHz in this report.

1 GHz to 18 GHz, ANT H, Low Channel



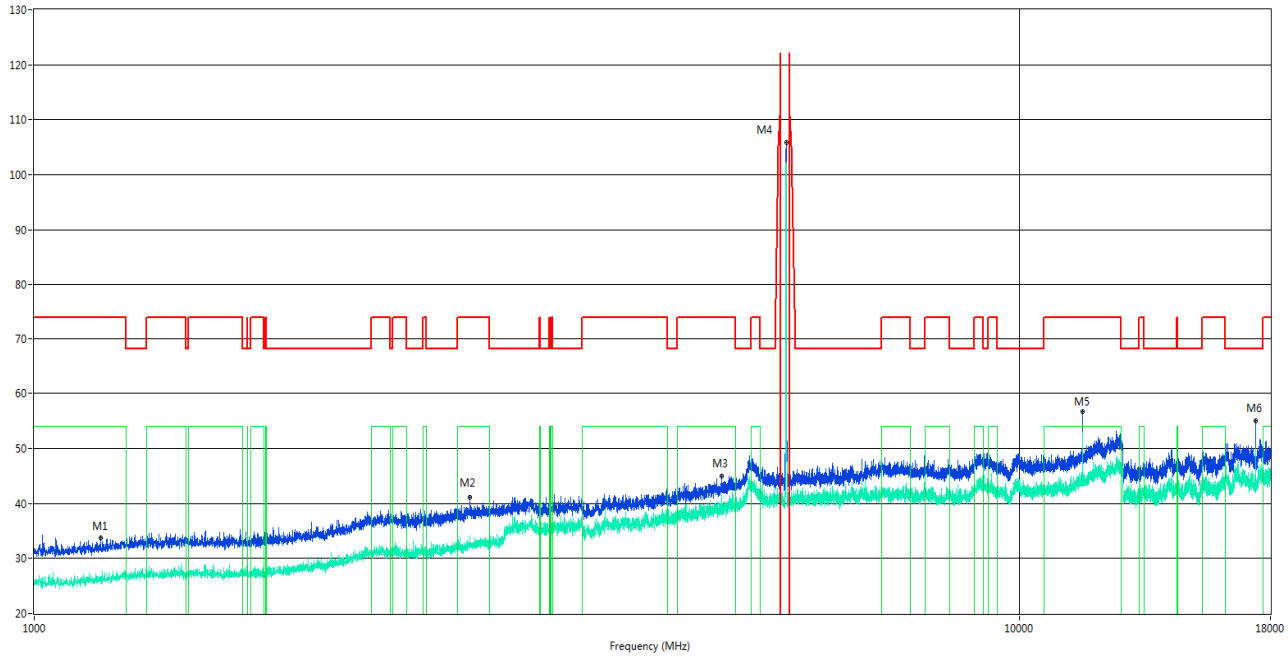
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1086.000	26.0	-16.18	54.0	28.00	AV	359.70	150	Horizontal	Pass
1	1086.000	35.08	-16.18	74.0	38.92	Peak	359.70	150	Horizontal	Pass
2**	2095.500	30.1	-13.61	--	-30.10	AV	203.70	150	Horizontal	N/A
2	2095.500	39.61	-13.61	68.2	28.59	Peak	203.70	150	Horizontal	Pass
3**	4129.000	37.2	-7.13	54.0	16.80	AV	288.00	150	Horizontal	Pass
3	4129.000	42.34	-7.13	74.0	31.66	Peak	288.00	150	Horizontal	Pass
4**	5720.000	44.8	-2.76	--	-44.80	AV	150.10	150	Horizontal	N/A
4	5720.000	110.8	-2.76	--	-110.8	Peak	150.10	150	Horizontal	Pass
5**	9130.375	43.1	15.50	54.0	10.90	AV	259.40	150	Horizontal	Pass
5	9130.375	49.26	15.50	74.0	24.74	Peak	259.40	150	Horizontal	Pass
6**	17196.751	53.1	17.88	--	-53.10	AV	299.10	150	Horizontal	N/A
6	17196.751	57.04	17.88	68.2	11.16	Peak	299.10	150	Horizontal	Pass

1 GHz to 18 GHz, ANT V, Low Channel



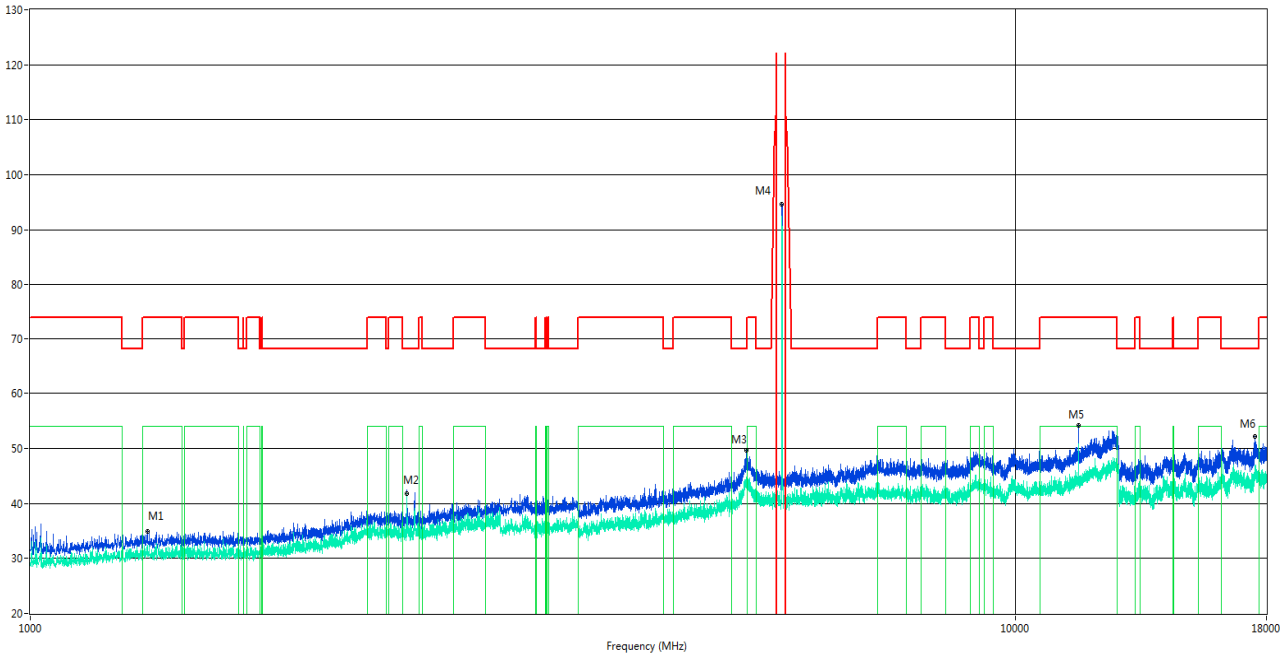
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1289.000	28.0	-16.23	--	-28.00	AV	34.40	150	Vertical	N/A
1	1289.000	35.05	-16.23	68.2	33.15	Peak	34.40	150	Vertical	Pass
2**	2244.500	32.7	-12.51	54.0	21.30	AV	359.60	150	Vertical	Pass
2	2244.500	39.37	-12.51	74.0	34.63	Peak	359.60	150	Vertical	Pass
3**	5181.000	48.3	-3.43	--	-48.30	AV	89.40	150	Vertical	N/A
3	5181.000	54.37	-3.43	68.2	13.83	Peak	89.40	150	Vertical	Pass
4**	5732.000	82.2	-2.42	--	-82.20	AV	325.00	150	Vertical	N/A
4	5732.000	96.41	-2.42	--	228.59	Peak	325.00	150	Vertical	Pass
5**	11464.875	47.7	15.46	54.0	6.30	AV	0.00	150	Vertical	Pass
5	11464.875	53.83	15.46	74.0	20.17	Peak	0.00	150	Vertical	Pass
6**	17196.751	47.4	17.88	--	-47.40	AV	29.20	150	Vertical	N/A
6	17196.751	52.22	17.88	68.2	15.98	Peak	29.20	150	Vertical	Pass

1 GHz to 18 GHz, ANT H, Middle Channel



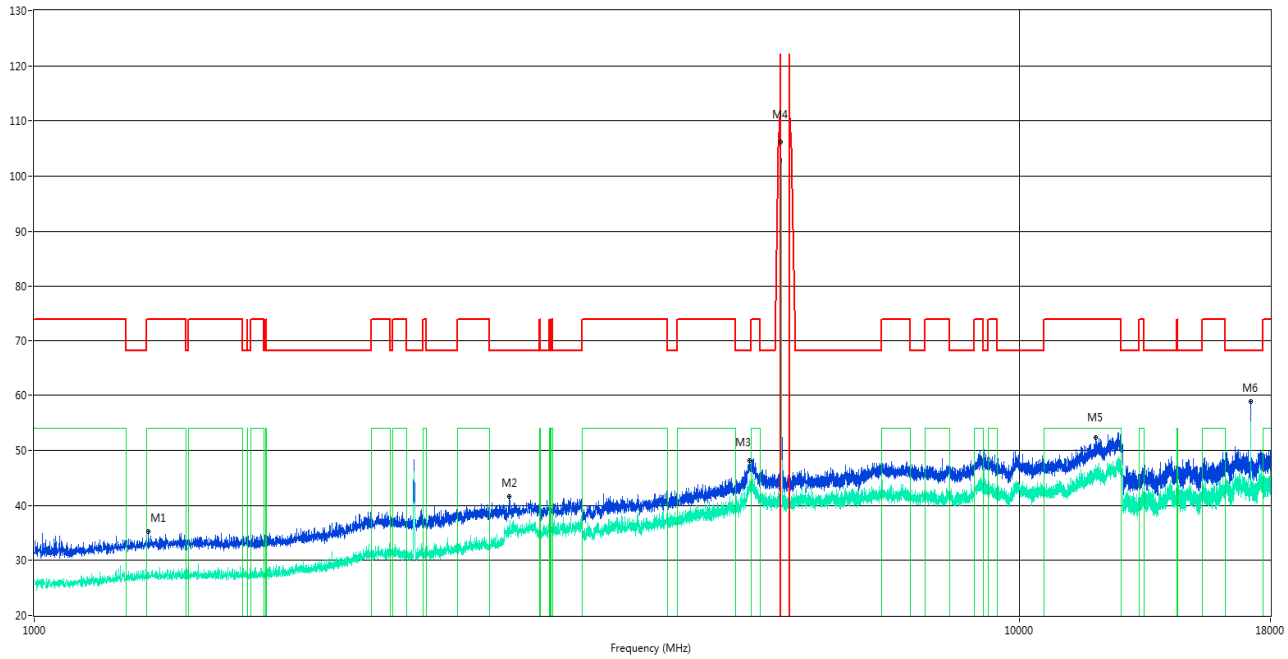
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1167.500	26.7	-16.12	54.0	27.30	AV	1.60	150	Horizontal	Pass
1	1167.500	33.81	-16.12	74.0	40.19	Peak	1.60	150	Horizontal	Pass
2**	2767.500	32.1	-9.77	54.0	21.90	AV	52.50	150	Horizontal	Pass
2	2767.500	41.13	-9.77	74.0	32.87	Peak	52.50	150	Horizontal	Pass
3**	4986.000	37.9	-4.36	54.0	16.10	AV	4.10	150	Horizontal	Pass
3	4986.000	44.99	-4.36	74.0	29.01	Peak	4.10	150	Horizontal	Pass
4**	5800.000	102.1	-2.87	--	-102.10	AV	23.20	150	Horizontal	N/A
4	5800.000	105.91	-2.87	--	-82.71	Peak	23.20	150	Horizontal	N/A
5**	11600.000	49.1	16.04	54.0	4.90	AV	358.70	150	Horizontal	Pass
5	11600.000	56.65	16.04	74.0	17.35	Peak	358.70	150	Horizontal	Pass
6**	17400.187	49.0	17.28	--	-49.00	AV	0.00	150	Horizontal	N/A
6	17400.187	55.01	17.28	68.2	13.19	Peak	0.00	150	Horizontal	Pass

1 GHz to 18 GHz, ANT V, Middle Channel



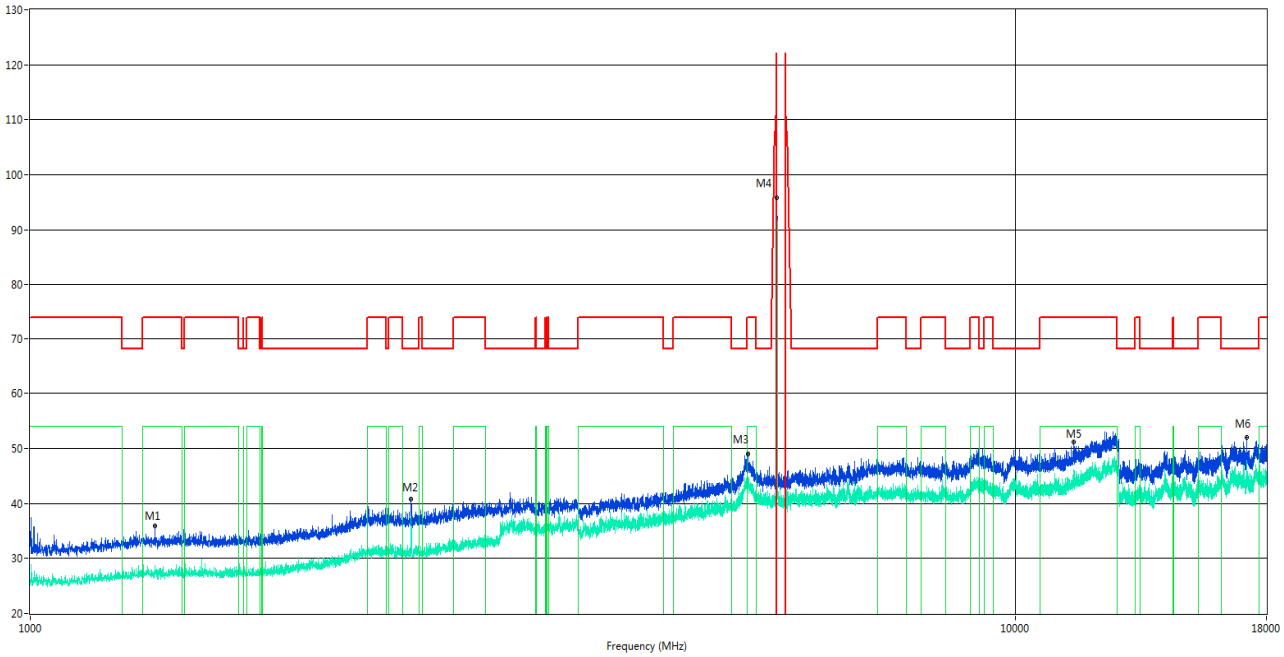
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1314.500	31.0	-16.03	54.0	23.00	AV	360.00	150	Vertical	Pass
1	1314.500	34.89	-16.03	74.0	39.11	Peak	360.00	150	Vertical	Pass
2**	2412.500	41.9	-12.15	--	-41.90	AV	206.80	150	Vertical	N/A
2	2412.500	42.43	-12.15	68.2	25.77	Peak	206.80	150	Vertical	Pass
3**	5331.000	44.9	0.70	--	-44.90	AV	3.80	150	Vertical	N/A
3	5331.000	49.67	0.70	68.2	18.53	Peak	3.80	150	Vertical	Pass
4**	5797.000	86.3	-2.68	--	-86.30	AV	215.30	150	Vertical	N/A
4	5797.000	94.63	-2.68	--	120.67	Peak	215.30	150	Vertical	Pass
5**	11600.000	46.7	16.04	54.0	7.30	AV	349.00	150	Vertical	Pass
5	11600.000	54.27	16.04	74.0	19.73	Peak	349.00	150	Vertical	Pass
6**	17536.688	44.8	19.34	--	-44.80	AV	65.80	150	Vertical	N/A
6	17536.688	52.22	19.34	68.2	15.98	Peak	65.80	150	Vertical	Pass

1 GHz to 18 GHz, ANT H, High Channel



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1306.000	27.1	-16.15	54.0	26.90	AV	66.30	150	Horizontal	Pass
1	1306.000	35.27	-16.15	74.0	38.73	Peak	66.30	150	Horizontal	Pass
2**	3038.000	34.7	-8.65	--	-34.70	AV	342.30	150	Horizontal	N/A
2	3038.000	41.68	-8.65	68.2	26.52	Peak	342.30	150	Horizontal	Pass
3**	5326.000	43.0	0.95	--	-43.00	AV	88.50	150	Horizontal	N/A
3	5326.000	48.11	0.95	68.2	20.09	Peak	88.50	150	Horizontal	Pass
4**	5733.000	101.9	-2.35	--	-101.90	AV	166.40	150	Horizontal	N/A
4	5733.000	106.18	-2.35	--	60.22	Peak	166.40	150	Horizontal	Pass
5**	11966.562	45.0	16.79	54.0	9.00	AV	154.80	150	Horizontal	Pass
5	11966.562	52.29	16.79	74.0	21.71	Peak	154.80	150	Horizontal	Pass
6**	17191.500	52.3	17.84	--	-52.30	AV	0.20	150	Horizontal	N/A
6	17191.500	58.96	17.84	68.2	9.24	Peak	0.20	150	Horizontal	Pass

1 GHz to 18 GHz, ANT V, High Channel



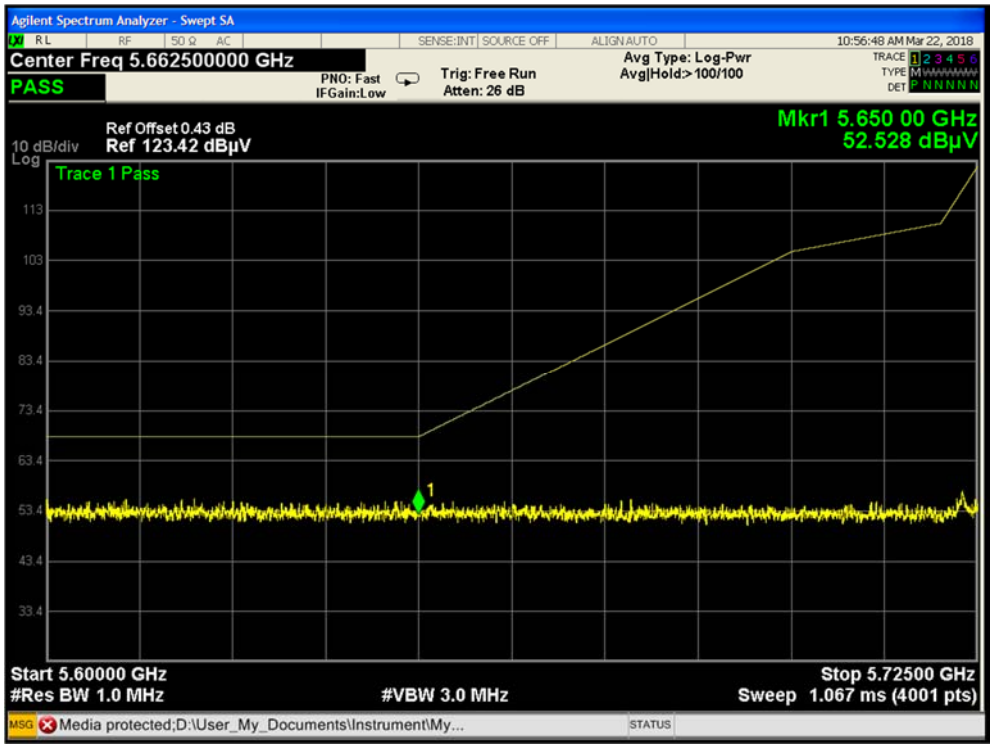
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1**	1339.000	27.5	-16.21	54.0	26.50	AV	342.60	150	Vertical	Pass
1	1339.000	35.86	-16.21	74.0	38.14	Peak	342.60	150	Vertical	Pass
2**	2436.500	36.5	-12.42	--	-36.50	AV	74.40	150	Vertical	N/A
2	2436.500	40.77	-12.42	68.2	27.43	Peak	74.40	150	Vertical	Pass
3**	5360.000	44.2	0.38	54.0	9.80	AV	359.40	150	Vertical	Pass
3	5360.000	48.94	0.38	74.0	25.06	Peak	359.40	150	Vertical	Pass
4**	5733.000	91.4	-2.35	--	-91.40	AV	306.10	150	Vertical	N/A
4	5733.000	95.74	-2.35	--	210.36	Peak	306.10	150	Vertical	Pass
5**	11466.313	46.1	15.46	54.0	7.90	AV	304.10	150	Vertical	Pass
5	11466.313	51.14	15.46	74.0	22.86	Peak	304.10	150	Vertical	Pass
6**	17191.500	43.6	17.84	--	-43.60	AV	0.00	150	Vertical	N/A
6	17191.500	52.01	17.84	68.2	16.19	Peak	0.00	150	Vertical	Pass

A.6.2 Band Edge (Restricted-band)

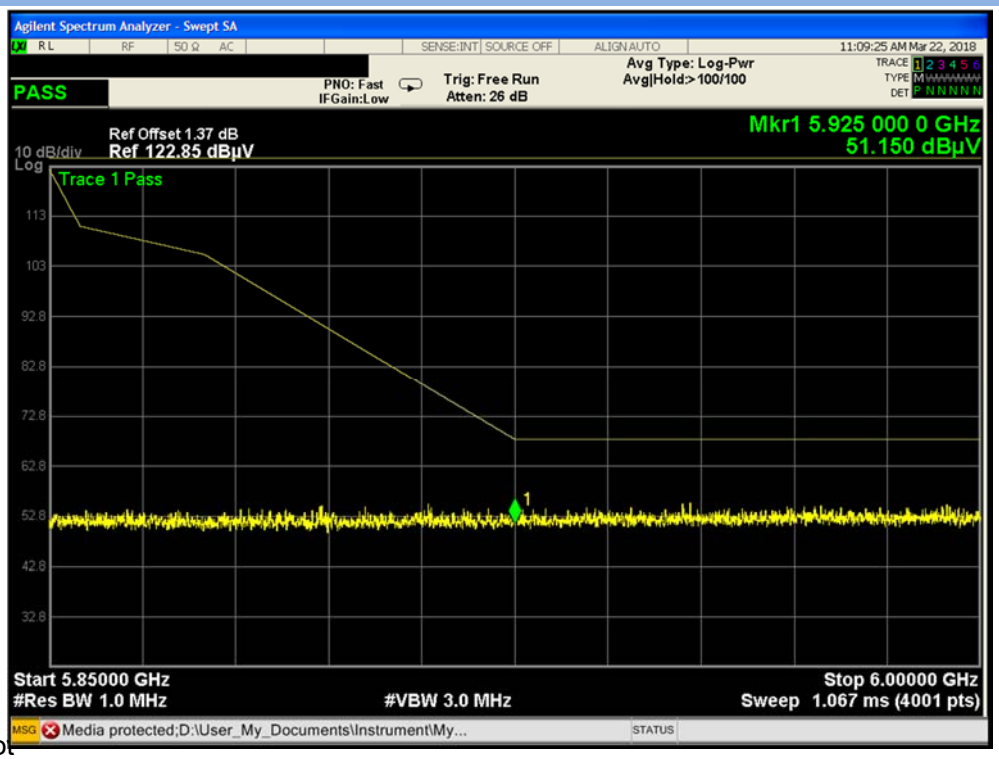
Test Band (MHz)	Channel	Verdict
5725 -5850	Low	Pass
	High	Pass

Test Plots

LOW CHANNEL



HIGH CHANNEL



est Data and Plot

A.8 Frequency Stability

Measurement Data (the worst channel)

Voltage vs. Frequency Stability

Test Conditions		Test Frequency (MHz)	0 Minute		2 Minute		5 Minute		10Minute	
TEMP. (°C)	Voltage (VDC)		Measurement Frequency (MHz)	Max. Deviation (ppm)	Measurement Frequency (MHz)	Max. Deviation (ppm)	Measurement Frequency (MHz)	Max. Deviation (ppm)	Measurement Frequency (MHz)	Max. Deviation (ppm)
20	3.0	LOW CHANNEL	5731.99153	-1.48	5731.975334	-4.30	5731.986742	-2.31	5731.971473	-4.98
	3.8		5732.025512	4.45	5732.01291	2.25	5732.031456	5.49	5732.043572	7.60
	4.35		5732.006013	1.05	5732.024257	4.23	5732.02065	3.60	5732.01919	3.35

Temperature vs. Frequency Stability

Test Conditions		Test Frequency (MHz)	0 Minute		2 Minute		5 Minute		10Minute	
Voltage (VDC)	TEMP. (°C)		Measurement Frequency (MHz)	Max. Deviation (ppm)	Measurement Frequency (MHz)	Max. Deviation (ppm)	Measurement Frequency (MHz)	Max. Deviation (ppm)	Measurement Frequency (MHz)	Max. Deviation (ppm)
3.8	5	LOW CHANNEL	5731.963287	-6.40	5731.975345	-4.30	5731.958633	-7.22	5731.988319	-2.04
	15		5732.028439	4.96	5732.012676	2.21	5732.023637	4.12	5732.035566	6.20
	25		5731.950708	-8.60	5731.992706	-1.27	5731.999984	0.00	5731.957596	-7.40
	35		5732.009442	1.65	5732.020579	3.59	5732.009086	1.59	5732.044067	7.69
	45		5732.00927	1.62	5732.010794	1.88	5732.047905	8.36	5732.021827	3.81

ANNEX B TEST SETUP PHOTOS

Please refer the document “BL-EC1830066-AR2.PDF”.

ANNEX C EUT EXTERNAL PHOTOS

Please refer the document “BL-EC1830066-AW1.PDF”.

ANNEX D EUT INTERNAL PHOTOS

Please refer the document “BL-EC1830066-AI1.PDF”.

--END OF REPORT--